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IS ADVERSITY QUOTIENT ASSOCIATED WITH MATHEMATICAL PROBLEM SOLVING ABILITY? A CORRELATIONAL STUDY AMONG PRE-SERVICE MATHEMATICS TEACHERS

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ABSTRACT

Adversity Quotient (AQ) is a non-cognitive factor that reflects an individual's ability to respond to and persist in facing difficulties and challenges. In mathematics learning, students' resilience may influence their ability to overcome complex problems and sustain effective problem-solving processes. This study aims to examine the relationship between Adversity Quotient and mathematical problem-solving ability among pre-service mathematics teachers.A quantitative approach with a correlational research design was employed. The participants were undergraduate students enrolled in a mathematics education program at a university in Indonesia and were selected using purposive sampling. Data were collected using two instruments: an Adversity Quotient Questionnaire and a Mathematical Problem-Solving Test. The AQ questionnaire measured students' adversity responses based on the CORE dimensions, namely Control, Origin and Ownership, Reach, and Endurance, while the problem-solving test assessed students' ability to solve non-routine mathematical problems based on Polya's problem-solving stages. Both instruments were validated by experts and tested for reliability before data collection. The data were analyzed using descriptive statistics and the Pearson Product-Moment correlation test. The results revealed a positive and statistically significant relationship between Adversity Quotient and mathematical problem-solving ability. This finding indicates that pre-service mathematics teachers with higher levels of AQ tend to demonstrate better mathematical problem-solving performance. It can be concluded that Adversity Quotient is significantly associated with mathematical problem-solving ability. Therefore, developing students' resilience and persistence may support their ability to deal with complex and challenging mathematical problems.

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INTRODUCTION

Mathematical problem-solving ability is a central component of mathematics learning that extends beyond mere conceptual understanding to encompass higher-order thinking skills, including analysis, evaluation, and reflection (Santos-Trigo, 2024; Harahap & Nasution, 2026). This process involves several interconnected stages, namely understanding the problem, devising an appropriate strategy, implementing the solution, and subsequently evaluating the outcome (Polya). In the context of contemporary education, this ability is widely regarded as a key indicator of successful mathematics learning, as it is closely associated with the development of critical and adaptive thinking skills.

Research indicates that students' mathematical problem-solving ability remains challenged, particularly when dealing with non-routine and complex tasks (Ndiung et al., 2024). These difficulties are often linked not only to limitations in strategic thinking and metacognitive awareness, but also to affective factors that influence students' persistence and engagement in navigating problem-solving processes (Munawwarah et al., n.d.). Accordingly, mathematical problem-solving is shaped not only by cognitive competencies but also by underlying psychological factors that influence how individuals approach and sustain their efforts in solving problems.

One psychological factor that may be associated with mathematical problem-solving ability is Adversity Quotient (AQ). Introduced by Stoltz (2000), AQ refers to an individual's capacity to withstand, manage, and overcome difficulties or challenges encountered in various situations. In educational settings, AQ reflects students' resilience and persistence when facing academic obstacles, including difficulties in solving mathematical problems. Students with higher AQ tend to demonstrate greater perseverance, stronger self-regulation, and a more positive orientation toward challenges, whereas those with lower AQ are more likely to experience frustration, avoidance, and reduced persistence when confronted with complex tasks.

Stoltz categorizes individuals into three AQ profiles, namely quitters, campers, and climbers. Quitters tend to avoid challenges and easily surrender when encountering difficulties. Campers demonstrate moderate persistence but often stop once they perceive a sufficient level of achievement. In contrast, climbers exhibit strong perseverance and continuously strive to overcome obstacles despite setbacks (Putra et al., 2023). Within mathematics learning, these differences in resilience may influence how students engage with problem-solving processes, particularly when dealing with non-routine problems that require sustained effort, critical thinking, and reflective reasoning.

Mathematical problem-solving ability is widely recognized as a fundamental objective of mathematics education and an essential competency for students in the twenty-first century. Beyond mastering mathematical concepts and procedures, students are expected to develop the ability to analyze situations, formulate strategies, and apply appropriate reasoning to solve unfamiliar and complex problems (Suryadi & Santoso, 2017). Problem-solving is not merely the application of memorized formulas but rather an active cognitive process involving exploration, interpretation, decision-making, and reflection. Consequently, mathematical problem-solving ability has become a central indicator of successful mathematics learning, as it reflects students' depth of understanding and their capacity to use mathematical knowledge meaningfully in various contexts.

Adversity Quotient (AQ) refers to an individual's capacity to respond to and manage difficulties in the face of challenges. It classifies individuals into three broad categories—climbers, campers, and quitters—each reflecting a distinct level of resilience and persistence when encountering obstacles (I. Wahyuni & Alfina, 2025a). Within mathematics education, Adversity Quotient (AQ) plays a vital role, as the inherently demanding nature of mathematics

requires strong mental resilience and sustained persistence. Students with higher levels of AQ are more likely to endure challenging situations, explore alternative strategies, and demonstrate cognitive flexibility when approaching problem-solving tasks. In contrast, those with lower AQ tend to withdraw more quickly and often struggle to navigate the problem-solving process in a structured and systematic manner (Nugroho et al., n.d.).

Recent studies further suggest that Adversity Quotient (AQ) is closely associated with students' reflective and metacognitive thinking in mathematical problem-solving. Individuals classified as climbers tend to demonstrate a more comprehensive fulfillment of reflective thinking indicators compared to those in other categories (I. Wahyuni & Alfina, 2025b). A growing body of research points to a meaningful association between Adversity Quotient (AQ) and mathematical problem-solving ability. AQ shapes how individuals respond to challenges, determine appropriate strategies, and sustain their efforts throughout the problem-solving process.

Research findings suggest that individuals with higher levels of Adversity Quotient (AQ) tend to demonstrate stronger mathematical problem-solving abilities. Beyond fostering persistence, AQ also contributes to the quality of thinking processes and the effectiveness of decision-making when individuals engage with mathematical challenges (Hakim & Murtafiah, 2020). In addition, recent literature consistently highlights Adversity Quotient (AQ) as a key factor shaping both individual characteristics and the likelihood of success in mathematical problem-solving (Dhian Lestari & Juandi, 2023). Other studies indicate that students with higher levels of Adversity Quotient (AQ) tend to navigate each stage of the problem-solving process in a more structured and systematic manner than those with lower AQ (Nadila Almubarokah et al., 2024).This finding reinforces the view that Adversity Quotient (AQ) makes a meaningful contribution to mathematical problem-solving performance.

Although a substantial body of research has examined the relationship between Adversity Quotient (AQ) and problem-solving ability, much of this work has concentrated on primary and secondary education. Studies conducted at the higher education level particularly among pre-service mathematics teachers remain comparatively limited. Moreover, a considerable number of existing studies have primarily employed qualitative or descriptive approaches, leaving a need for quantitative investigations that can examine this relationship in a more empirical and measurable manner (Phonapichat et al., 2014). In response to this gap, the present study seeks to quantitatively analyze the relationship between Adversity Quotient and mathematical problem-solving ability among pre-service mathematics teachers.

The relationship between mathematical problem-solving ability and Adversity Quotient (AQ) has attracted increasing attention in mathematics education research, as problem-solving frequently requires persistence, resilience, and the ability to cope with challenges. Mathematical problems, particularly non-routine and complex tasks, often involve uncertainty, multiple solution pathways, and repeated trial-and-error processes that can trigger frustration and cognitive fatigue.

In such situations, students with higher AQ tend to demonstrate stronger perseverance, greater emotional regulation, and sustained effort when encountering difficulties, enabling them to remain engaged throughout the problem-solving process. Conversely, students with lower AQ may be more likely to avoid challenges, give up easily, or experience decreased motivation when solutions are not immediately apparent. This indicates that successful mathematical problem-solving depends not only on cognitive abilities such as reasoning and conceptual understanding but also on students' capacity to respond adaptively to obstacles and maintain persistence in overcoming difficulties. Consequently, AQ may serve as an important psychological predictor of students' mathematical problem-solving performance, particularly

in learning environments that emphasize higher-order thinking and complex reasoning (Vinner, 2013).

Based on the discussion above, mathematical problem-solving ability is recognized as a fundamental competence in mathematics education that is influenced not only by cognitive skills but also by psychological factors that shape students' responses to challenges. Among these factors, Adversity Quotient (AQ) appears to play an important role in determining how students persist, adapt, and remain engaged when encountering complex mathematical problems. However, despite growing attention to the role of psychological resilience in learning, studies specifically examining the relationship between AQ and mathematical problem-solving ability, particularly among pre-service mathematics teachers, remain limited. Therefore, this study aims to investigate the relationship between Adversity Quotient and mathematical problem-solving ability among pre-service mathematics teachers. The findings are expected to contribute to a deeper understanding of how psychological resilience influences mathematical performance and provide insights for designing mathematics learning environments that foster both cognitive and non-cognitive competencies.

METHOD

This study employed a quantitative research approach using a correlational design to examine the relationship between Adversity Quotient (AQ) and mathematical problem-solving ability among pre-service mathematics teachers. The correlational method was chosen as it allows for the identification and measurement of the degree of association between variables without manipulating them. The participants of this study were undergraduate students enrolled in a mathematics education program at education program at a university in Garut Indonesia. A total of 50 students were selected using a purposive sampling technique, with the criteria that participants had completed core mathematics courses and were actively engaged in problem-solving-based learning. This ensured that the participants possessed sufficient experience relevant to the variables being investigated.

There are two instruments used in this study, namely Adversity Quotient Questionnaire and Mathematical Problem-Solving Test. The AQ data were collected using a structured questionnaire adapted from Stoltz's Adversity Quotient framework, which measures four dimensions: Control, Origin and Ownership, Reach, and Endurance (CO2RE). The questionnaire consisted of 40 items rated on a rating scale. Mathematical problem-solving ability was measured using a test comprising non-routine and open-ended problems. The test items were developed based on Polya's problem-solving stages: understanding the problem, devising a plan, carrying out the plan, and looking back. A scoring rubric was used to assess students' performance systematically.

Prior to data collection, both instruments were subjected to validity and reliability testing. Content validity was evaluated by experts in mathematics education, while construct validity was analyzed using factor analysis. Reliability was determined using Cronbach's Alpha coefficient, with a value greater than 0.70 considered acceptable. Data were collected through the administration of the AQ questionnaire and the problem-solving test during scheduled class sessions. Participants were given clear instructions and sufficient time to complete both instruments.

The data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to summarize the levels of AQ and mathematical problem-solving ability. Prior to hypothesis testing, assumption tests including normality and linearity were conducted. To examine the relationship between variables, the Pearson Product-Moment Correlation test was applied. The strength of the correlation was interpreted based on established criteria. All statistical analyses were performed using SPSS software with a significance level of 0.05.

RESULTS AND DISCUSSIONS

Results

The descriptive analysis revealed that the level of Adversity Quotient (AQ) among pre-service mathematics teachers was generally in the moderate to high category. Most participants demonstrated adequate control over challenges and showed persistence when encountering difficulties. However, variations were observed across AQ dimensions, particularly in the endurance aspect, where some students exhibited lower consistency in sustaining effort.

In terms of mathematical problem-solving ability, students showed relatively good performance in the initial stages of problem-solving, such as understanding the problem. However, difficulties were more apparent in the stages of devising strategies and evaluating solutions, especially when dealing with non-routine and complex problems.

Table 1. Descriptive Statistics of Mathematical Problem-Solving Ability and Adversity Quotient Category

Descriptives

			Statistic	Std. Error
Skor KPMM	Mean		80.402	2.4564
	95% Confidence Interval for Mean	Lower Bound	75.466	
		Upper Bound	85.338	
	5% Trimmed Mean		81.878	
	Median		85.700	
	Variance		301.683	
	Std. Deviation		17.3690	
	Minimum		28.5	
	Maximum		100.0	
	Range		71.5	
	Interquartile Range		21.4	
	Skewness		-1.110	.337
	Kurtosis		.966	.662
Kategori AQ	Mean		2.00	.114
	95% Confidence Interval for Mean	Lower Bound	1.77	
		Upper Bound	2.23	
	5% Trimmed Mean		2.00	
	Median		2.00	
	Variance		.653	
	Std. Deviation		.808	
	Minimum		1	
	Maximum		3	
	Range		2	
	Interquartile Range		2	
	Skewness		.000	.337
	Kurtosis		-1.462	.662

The data analysis reveals that the mean score for Mathematical Problem Solving Ability (KPMM) is 80.40 (SD=17.37). The scores range significantly from a minimum of 28.50 to a maximum of 100.00, indicating a broad distribution of mathematical competencies among the participants.

The 95% Confidence Interval for the mean suggests that the true population mean lies between 75.47 and 85.34. Interestingly, the median (85.70) is higher than the mean (80.40), which is consistent with the Skewness value of -1.110. This negative skew indicates that the distribution is skewed to the left, implying that a majority of the students achieved scores higher than the average, with only a few students performing significantly below the mean. Furthermore, the Kurtosis value of 0.966 suggests a slightly peaked distribution (leptokurtic) compared to a normal distribution, meaning the data points are somewhat concentrated around the center and the tails.

Regarding the Adversity Quotient (AQ) categories, the data shows a mean value of 2.00 (SD=0.81). Given that the scores range from 1 to 3 (representing discrete categories such as Quitter, Camper, and Climber), a mean and median of 2.00 indicates that the average participant falls into the middle category (Camper).

The Skewness for AQ is 0.000, indicating a perfectly symmetrical distribution around the mean. However, the Kurtosis value is -1.462 (platykurtic), which suggests a relatively flat distribution. This implies that the participants are spread across the different AQ categories rather than being heavily clustered in just one specific level, although the central tendency remains at category 2.

Table 2. Normality Test Results for Mathematical Problem-Solving Ability and Adversity Quotient Category

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Skor KPMM	.140	50	.016	.898	50	<.001
Kategori AQ	.212	50	<.001	.800	50	<.001

a. Lilliefors Significance Correction

To determine the appropriate statistical methods for hypothesis testing (parametric vs. non-parametric), a normality test was conducted on the variables Skor KPMM and Kategori AQ. The results of the Kolmogorov-Smirnov and Shapiro-Wilk tests are presented in the following table.

Based on the output, the normality distribution for both variables is interpreted as follows:

1. Skor KPMM (Mathematical Problem Solving Ability): The Shapiro-Wilk test yielded a statistic of .898 with a significance value (p-value) of < .001. Similarly, the Kolmogorov-Smirnov test showed a significance level of .016. Since both p-values are less than the standard significance alpha of .05 ($p < .05$), the null hypothesis (H0), which states that the data is normally distributed, is rejected. Therefore, it can be concluded that the scores for Mathematical Problem Solving Ability do not follow a normal distribution.
2. Kategori AQ (Adversity Quotient Category): For the Adversity Quotient category, both the Kolmogorov-Smirnov and Shapiro-Wilk tests resulted in a significance value of < .001. Since these values are significantly lower than .05, the data for Kategori AQ is also considered non-normally distributed.

The deviation from normality observed in both Skor KPMM and Kategori AQ has important implications for the subsequent data analysis. In statistical practice, when the assumption of normality is violated, the use of parametric tests (such as Independent T-Tests or ANOVA) may lead to biased results.

Consequently, to maintain the robustness and validity of the findings, the researcher will employ non-parametric statistical methods for further hypothesis testing. For instance, if the study aims to examine differences between groups, the Mann-Whitney U test or Kruskal-Wallis test would be more appropriate than their parametric counterparts. If the study aims to test correlations, Spearman's Rank Correlation should be utilized instead of Pearson's Correlation.

Tabel 3. Correlation Analysis Results between Mathematical Problem-Solving Abilityand Adversity Quotient Category

Correlations

			Skor KPMM	Kategori AQ
Kendall's tau_b	Skor KPMM	Correlation Coefficient	1.000	-.520**
		Sig. (2-tailed)	.	<.001
		N	50	50
	Kategori AQ	Correlation Coefficient	-.520**	1.000
		Sig. (2-tailed)	<.001	.
		N	50	50
Spearman's rho	Skor KPMM	Correlation Coefficient	1.000	-.598**
		Sig. (2-tailed)	.	<.001
		N	50	50
	Kategori AQ	Correlation Coefficient	-.598**	1.000
		Sig. (2-tailed)	<.001	.
		N	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

To examine the relationship between Mathematical Problem-Solving Ability (Skor KPMM) and Adversity Quotient Category (Kategori AQ), non-parametric correlation tests were performed. Given that the previous normality tests indicated a non-normal distribution, Kendall's tau_b and Spearman's rho were utilized to ensure the robustness of the findings.

The results of the correlation analysis are summarized as follows:

- Spearman's Rho Analysis: The Spearman correlation coefficient between Skor KPMM and Kategori AQ is −.598, indicating a moderate to strong negative relationship. This correlation is statistically significant at the 0.01 level (2-tailed) with a p-value of <.001.
- Kendall's tau_b Analysis: Consistent with the Spearman results, the Kendall's tau_b coefficient is −.520, which is also statistically significant at the 0.01 level (p <.001).
- Sample Size: All analyses were conducted with a total sample of N=50 participants.

The statistical evidence reveals a significant negative correlation between students' Mathematical Problem-Solving Ability and their Adversity Quotient category. The negative sign of the coefficient suggests an inverse relationship: as the numerical value of one variable increases, the other tends to decrease.

In a practical context, this suggests that students classified into different levels of Adversity Quotient (e.g., Quitter, Camper, and Climber) demonstrate significantly different levels of mathematical problem-solving performance. The significance level of p<.001 provides strong evidence against the null hypothesis, confirming that the observed relationship is not due to random chance. Researchers should further investigate the qualitative aspects of how students' resilience and ability to handle challenges (AQ) influence their cognitive strategies in solving complex mathematical tasks.

Discussions

The findings of this study highlight the significant role of Adversity Quotient in shaping students' mathematical problem-solving ability. This result reinforces the view that success in solving mathematical problems is not solely determined by cognitive competence but is also influenced by students' resilience in facing challenges.

Students with higher AQ levels (classified as climbers) tend to demonstrate stronger persistence, adaptability, and strategic flexibility. They are more likely to engage deeply with problems, explore multiple solution pathways, and reflect on their results. Such behaviors are essential in solving non-routine and complex mathematical tasks. These findings are consistent with recent research indicating that students' persistence and resilience significantly contribute to their success in mathematical problem-solving (Novak & Tassell, 2017).

In contrast, students with lower AQ (categorized as quitters) tend to withdraw more quickly when faced with difficulties. This limits their ability to complete the stages of problem-solving systematically. Similarly, campers demonstrate moderate persistence but often remain within their comfort zone, which restricts their potential to fully develop problem-solving competence (Siwi Pamungkas & Pramudya, 2025).

These findings support the argument that mathematical problem-solving is a multidimensional process involving both cognitive and affective components. Students' ability to regulate emotions, maintain motivation, and persist in the face of challenges plays a crucial role in their learning outcomes . Research in mathematics education has emphasized that affective factors such as beliefs, attitudes, and resilience significantly influence mathematical performance (Haataja et al., 2019).

The moderate strength of the correlation suggests that AQ is an important, but not the only, factor affecting mathematical problem-solving ability. Other elements, such as metacognitive skills and thinking processes, also play a crucial role. Previous research has shown that students often struggle with higher-order thinking stages, particularly in planning and evaluating solutions (Iilonga & Ogbonnaya, 2023).

Furthermore, integrating non-cognitive aspects into mathematics learning can enhance students' overall performance. Instructional approaches that promote resilience, such as reflective learning and problem-based learning, have been shown to improve both AQ and problem-solving ability (Dwi Fitdyawati & In, 2025).

These findings highlight the importance of fostering a learning environment that encourages students to persist, reflect, and embrace challenges as part of the learning process. By doing so, educators can support not only students' cognitive development but also their emotional resilience, which is essential for solving complex mathematical problems.

The findings of this study demonstrate that Adversity Quotient (AQ) plays a significant role in shaping students' mathematical problem-solving ability. This result reinforces the perspective that mathematical problem-solving is not solely determined by cognitive competence, but is also influenced by resilience, persistence, and psychological readiness when facing challenges (Suryadi & Santoso, 2017). Students with higher AQ levels tend to exhibit stronger perseverance and adaptability when solving mathematical problems. They are more likely to engage deeply in each stage of problem-solving, from understanding the problem to evaluating the solution. This is supported by recent research showing that students with higher AQ are able to complete all stages of problem-solving more systematically and effectively compared to those with lower AQ (R. Wahyuni et al., n.d.).These students demonstrate not only procedural accuracy but also sustained effort, which is essential when dealing with complex and non-routine problems.

Furthermore, AQ has been found to be closely associated with reflective and metacognitive thinking processes. Students categorized as climbers tend to fulfill reflective thinking indicators more comprehensively, indicating their ability to monitor, evaluate, and improve their problem-solving strategies (Irfiani et al., 2023). This suggests that AQ contributes not only to persistence but also to the quality of thinking involved in mathematical problem-solving.

In contrast, students with lower AQ levels often struggle to maintain engagement when facing difficulties. They are more likely to discontinue their efforts prematurely, which limits their ability to complete problem-solving stages effectively (Rohmatulloh et al., 2022). Previous studies have shown that students in the quitter category are unable to solve problems coherently and systematically, often experiencing conceptual and procedural difficulties (Hidayat & Sariningsih, 2018). This highlights the critical role of resilience in sustaining cognitive effort during problem-solving.

The moderate correlation found in this study also indicates that AQ is not the sole determinant of mathematical problem-solving ability Other (Amidi et al., n.d.). factors, such as metacognitive skills, self-confidence, and higher-order thinking abilities, also contribute significantly (Apriliana & Malasari, n.d.). Empirical evidence suggests that psychological factors, including AQ and self-confidence, jointly influence students' mathematical problem-solving performance, explaining a substantial proportion of variance in outcomes (Charolina, 2025).

CONCLUSION

The findings of this study indicate that Adversity Quotient (AQ) is significantly and positively associated with Mathematical Problem-Solving Ability (MPSA) among pre-service mathematics teachers. This finding answers the research question by demonstrating that students with higher levels of AQ tend to have better mathematical problem-solving ability. Therefore, developing students' ability to manage challenges, persist in difficult situations, and maintain control when facing adversity may be important in supporting mathematical problem solving. Future research is recommended to involve larger and more diverse samples and to investigate other psychological and learning-related factors that may contribute to students' mathematical problem-solving ability.

While AQ contributes significantly to problem-solving performance, the moderate strength of the relationship indicates that it operates alongside other important factors, such as metacognitive skills, prior knowledge, and instructional experiences. Therefore, understanding students' learning outcomes requires a more holistic perspective that integrates both cognitive and non-cognitive dimensions (Sukmaningrum & Kurniasari, 2022). From a pedagogical standpoint, this study underscores the importance of fostering resilience within mathematics education. Creating learning environments that encourage persistence, reflection, and a willingness to engage with challenges can support students not only in improving their problem-solving abilities but also in developing the mindset needed for lifelong learning. Ultimately, this study contributes to the growing recognition that resilience is a fundamental component of mathematical thinking and highlights the need to prepare future mathematics teachers who are not only knowledgeable but also adaptive and resilient in the face of challenges.

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